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## ***APEC 2018: A Preview Of The Power Semiconductors And Application Demos You'll See In This Year's Expo***

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If you're interested in exploring the latest power semiconductor devices and reference designs for a broad range of existing and emerging power electronics applications, the exhibition at APEC likely presents one of your best opportunities to do so. While the technical conference is what built the Applied Power Electronics Conference (APEC), its expo has become the largest power electronics focused exhibition in North America. This year's APEC will be held March 4-8 at the Henry B. Gonzalez Convention Center in downtown San Antonio, Texas.

Over the years, the exhibit has grown to include many more non-semiconductor product makers than semiconductor manufacturers. In fact, it includes vendors of every type of component, test instrument, design tool and related products for designing power converters, power supplies and power systems. Nevertheless, much of what's new concerns the discrete power semiconductors, power ICs, power modules and associated reference designs that the semiconductor companies are exhibiting.

Browsing this APEC Expo preview, you'll see lots of wide-bandgap (GaN and SiC) semiconductors and gate drivers, specialized PWM controllers, power modules, buck regulators and chips for wireless power and USB Type-C applications. These two applications figure prominently among the demos which also include EV applications and some of the emerging applications such as LiDAR. These themes will be familiar for anyone who has attended APEC in recent years, but even for those who already know the trends, the displays and demos offer a quick overview of the progress made in development of the components and applications.

This article presents a preview of these products as well as a handful of passive components, test instruments and design tools. For the benefit of those who plan to walk the actual expo floor, this article presents its descriptions of the exhibited products in order of booth number. In addition to highlighting the products to be displayed or demo'd in the expo, this article also calls out some of the related exhibitor presentations that representatives of these companies will be giving in the industry sessions and other forums.

The following exhibitors are featured here:

- Apex Microtechnology, booth 427 (Semiconductors)
- Typhoon HIL, booth 437 (Design tools)
- Texas Instruments, booth 501 (Semiconductors)
- GMW Associates, booth 544 (Test and measurement)
- ON Semiconductor, booth 601 (Semiconductors, Sensors)
- Vishay, booth 609 (Semiconductors and Passives)
- TT Electronics, booth 625 (Passives and Magnetics)
- Ametherm, booth 640 (Circuit protection)
- Infineon Technologies, booth 701 (Semiconductors)
- Rohm Semiconductor, booth 709 (Semiconductors)
- NH Research, booth 727 (Test and measurement)
- STMicroelectronics, booth 803 (Semiconductors)
- Payton Planar, booth 819 (Magnetics)
- Mitsubishi Electric US, booth 919 (Semiconductors)
- Wolfspeed, booth 1008 (Semiconductors)
- GaN Systems, booth 1041 (Semiconductors)
- Dialog Semiconductor, booth 1155 (Semiconductors)
- Power Integrations, booth 1245 (Semiconductors)
- Efficient Power Conversion, booth 1255 (Semiconductors)
- OPAL-RT Technologies, booth 1326 (Design tools)
- Renesas, booth 1436 (Semiconductors)
- Baknor Thermal Management, booth 1718 (Heatsinks)

- SABIC, booth #1728  
For a full list of APEC 2018 exhibitors, see the conference [website](#).

### **Apex Microtechnology, booth 427**

Apex Microtechnology will display a number of new power op amps and the new features in its power design software. Among the new products are the [PA164/PA165](#) high density multi-purpose power operational amplifiers with ratings up to 200 V and 10 A peak. Introduced last fall, these amplifiers are meant for use in programmable voltage and current sources.

Two other new products being shown include the [MP106](#), a fixed gain amplifier with -36-V output voltage swing and 30-A peak output current; and the [MP204](#), a four-channel amplifier capable of 7.5 A per channel and 20-W internal power dissipation per channel. (These were just introduced in late January.) These amps were specifically designed to drive industrial inkjet print heads, which are highly capacitive. Apex Microtechnology will also show previously introduced products such as the PA99, a general purpose power op amp capable of 2400-Vp-p and 50-mA output.

To support its products, the company offers its Power Design Software Tool. From part selection to schematic generation, Power Design guides users through all the first steps in working with high power analog circuits. Those visiting the booth can see the new features added in the latest update. These features include a power filter designer, PWM efficiency calculators, automated closed-loop circuit designers and more.

### **Typhoon HIL, booth 437**

Typhoon HIL is bringing the HIL604: its high-end real-time controller hardware in the loop testbeds for development, testing and validation of control software of next-generation power electronics devices, systems and systems of systems. Together with the accompanying modeling and SCADA software, the HIL604 is said to provide engineers with the ultimate tool for model-based development and real-time experimentation with various converter control techniques, which significantly shorten the development cycle.

Moreover, thanks to Python-based API, testing can be automated, which greatly simplifies regression testing as control software gets modified to be in accordance with new standards and legislation. Finally, up to 16 HIL604 units can be paralleled, creating a real-time HIL super-simulator that can be used to design, test and optimize virtually any power-electronics system of systems such as a district-level microgrid, or the entire shipboard power system of a cruiser.

### **Texas Instruments, booth 501**

Texas Instruments will feature three demos including a 1.6-kW totem-pole PFC boost converter reference design, a gaming console power supply reference design, and a solar-to-vehicular charging ecosystem using SiC gate drivers.

The company's fully tested, totem-pole PFC converter reference design uses a 600-V GaN power stage, based on TI's LMG3410, and C2000 Piccolo F280049 microcontroller to achieve up to 99% efficiency. This 1-MHz high-density (165 x 84 x 40 mm) interleaved 1.6-kW design achieves a 70-W/in<sup>3</sup> power density, supporting server, telecom, and industrial power supplies. The design's hardware helps pass conducted emissions and surge requirements, and helps designers achieve 80 Plus Titanium specifications.

Texas Instruments will showcase a gaming console power supply, formerly with a non-TI LLC controller, now powered by TI's newest LLC controller UCC256301. According to the company, the UCC256301 demonstrates best-in-class transient response and light load performance with respect to efficiency and standby power. The 170-W auxless ac-dc power supply reference design demonstrates 79-mW no load standby power at 230 Vac with both the UCC256301 and UCC28056, a PFC controller. This enables designers to meet challenging energy standards like the Code of Conduct (CoC) Tier 2 and U.S. Department of Energy (DoE) Level VI efficiency standards and eliminates the flyback controller in the power supply.

TI's robust SiC gate drivers provide energy efficient and compact system designs with what the company claims is best-in-class isolation. Other features include noise immunity greater than 100 V/ns with integrated fast sensing and protection along with high drive strengths ( $\geq 6$  A) and excellent propagation delays ( $< 70$  ns).

The demo will show the solar-to-vehicular charging ecosystem, highlighting electricity generated by solar power and conditioned by a string inverter and charging pile for energy storage into the electric vehicle via an onboard charger. It features the UCC21520-Q1, ISO5852S and UCC5320S gate drivers and C2000 controller.

### **GMW Associates, booth 544**

GMW Associates will show its sensors and instrumentation for current and magnetic field measurement. These include current sensor ICs and closed-loop current transducers for voltage isolated dc-ac current measurement.

For example, the AKM CQ high frequency, low noise current sensors feature current ranges from  $\pm 4.5$  A to  $\pm 44$  A, accuracy  $< 1.3\%$ , a bandwidth (-3 dB) of dc to 1 MHz and 3 kV of isolation. Another family of sensors, the VAC closed-loop zero flux current sensors offer current ranges from  $\pm 200$  A to  $\pm 1000$  A, an accuracy within  $< 0.5\%$ , a bandwidth (-3 dB of dc to 50 kHz or dc to 100 kHz and a response time of  $< 1$   $\mu$ sec.)

The company will also feature the Danisense DC200IF high stability, high precision closed-loop fluxgate current transducer. This sensor features a current range of  $\pm 300$  A peak, 200 Arms; an accuracy within  $< 0.3\%$  from dc to 5 kHz: a bandwidth (-1 dB): dc to 200 kHz and a response time of  $< 1$   $\mu$ sec.

### **ON Semiconductor, booth 601**

ON Semiconductor will be making three new product announcements at APEC 2018 including two specialized PWM controllers and a family of SiC Schottky diodes.

One of the new controller ICs is a highly integrated device optimized for USB power delivery. This ac-dc PWM controller is designed to implement ultra-high density power adapters with up to 94% efficiency using an active clamp flyback topology. This topology enables zero voltage switching for high-efficiency, high-frequency solutions using lower-cost superjunction MOSFETs or high-performance eGaN FETs.

The other controller is the NCL30388 high power factor single-stage constant-current and constant-voltage primary-side regulated PWM controller for flyback, buck-boost and SEPIC topologies. This controller operates in a quasi-resonant mode to provide high efficiency. The device is highly integrated with a minimum number of external components. A robust suite of safety protection functions is built in to simplify the power supply design. The NCL30386 additionally provides very deep analog dimming output current with two dedicated dimming control input pin- ADIM and PDIM.

Meanwhile, ON Semiconductor's family of 650-V SiC Schottky diodes provides high switching capabilities at lower power losses and effortless paralleling of devices. The newly released diodes include surface mount and through hole packages with ratings ranging from 6 A to 50 A. All of the diodes provide zero reverse recovery, low forward voltage, temperature independent current stability, high surge capacity and positive temperature coefficient. The diodes are aimed at engineers designing PFC and boost converters for various applications including solar PV inverters, EV/HEV chargers, telecom power and data center power supplies while facing challenges to deliver smaller footprints at higher efficiencies.

Other ON Semi demonstrations planned for APEC include a smart passive sensor turnkey solution and a highly efficient, fully integrated synchronous buck regulator. For IoT applications, the smart passive sensor (SPS) solution enables remote sensing, data aggregation, analysis of temperature, moisture, proximity, and pressure. The solution incorporates all the required hardware and software into a single kit which is composed of sensor tags, reader, antenna and analytic software.

The new synchronous buck regulator utilizes a constant on-time control architecture and is capable of operating with an input range from 4.5 V to 18 V and supporting up to 30 A load current in a small 5-mm x 6-mm package. During APEC, visitors will be able to see a list of device features and abilities on screen and by selecting any of their choosing will be able to see them performed by the device. Depending on the tests selected, the audience will be able to see the outcome on an oscilloscope or a DMM. Similar tests can be done on competitor parts for comparison.

### **Vishay, booth 609**

Vishay's exhibit reflects its wide range of passive component products. However, the company will also be showing one of its new ICs, the SiC47x microBUCK regulator. This regulator is capable of up to 90 W of output power, 4.5-V to 55-V input operating voltage, and 4-A to 12-A output, in a compact 5-mm x 5-mm package.

### **TT Electronics, booth 625**

TT Electronics will show two of its newest products—the HPWC line of high pulse withstanding chip resistors and the HA19 common-mode choke for electric power steering.

The HPWC is the latest addition to the company's range of pulse withstanding chip resistor products. It is essentially a variant of PWC with no laser trimming applied. This maximizes the level of surge performance available in a single-sided flat chip design.

Available in four sizes from 0805 to 2512, HPWC withstands up to 6.5 kV peak for a 1.2/50  $\mu$ s surge and up to 3 kW for a 0.1 ms pulse. It is well suited for protection and discharge applications in compact power supplies and power control circuits where a resistance tolerance of 5% is adequate.

The HA19 common-mode choke is designed specifically for noise suppression applications found in the growth and expansion of new generation vehicles such as electric vehicles and plug-in hybrid vehicles. The HA19 series offer high efficiency and excellent current handling in a rugged construction. It is mechanically robust and features low dc resistance and low temperature rise performance. This choke is well suited for high efficiency electric power steering EMI applications where size and AEC-Q200 certification is critical.

### **Ametherm, booth 640**

Ametherm will be showcasing a wide range of its NTC and PTC inrush current limiters for reliable circuit protection and NTC thermistor sensors for high-accuracy temperature compensation and measurement. These include the MS35 and MM35-DIN series thermistors and the PANR 103395-342 NTC temperature probe.

Optimized for applications such as wind turbines, solar power inverters, battery chargers and dc-dc converters, the MS35 series is designed to withstand high input energy from 500 J to 750 J and steady-state current from 10 A to 50 A. These devices offer resistance at 25°C from 0.5  $\Omega$  to 20  $\Omega$  and thermal time constants from 65 s to 240 s. Featuring a diameter of 38 mm and thickness less than 10 mm, these thermistors do the same job as a power resistor and relay, yet in a smaller single-part alternative, saving valuable circuit board space.

The MM35-DIN series is designed to withstand high input energy of 1200 J and steady-state current from 50.0 A to 80.0 A at 680 V. Offered in DIN-rail-mountable packages, these inrush current limiters are optimized for high-power industrial and green energy applications, including variable frequency motor drives, wind turbines, large inverters, single- and three-phase motors and transformers. The MM35-DIN series features resistance at 25°C from 0.2  $\Omega$  to 1.5  $\Omega$ , with maximum power of 38.4 W.

The PANR 103395-342 features a ring lug for easy and secure mounting to battery terminals. This NTC thermistor temperature sensor is extremely accurate and experiences minimal drift from its initial electrical values to provide a high-stability replacement for thermocouples. The device features a high-dielectric withstand voltage, resistance at 25°C of 10 k $\Omega$ , beta of 3950°K and dissipation constant of 8 mW/°C.

### **Infineon Technologies, booth 701**

In their exhibit, Infineon will present several live demonstrations including

- XDPE digital controllers for high current applications and POL control for FPGA/SoC designs
- A comparison of thermal behavior of SoI and earlier generation JI devices
- 1200-V gate driver ICs matched with SiC MOSFETS
- Intelligent power modules driving a high efficiency ceiling fan
- 16-W Class E GaN for wireless charging
- Wireless charging solutions for consumer and automotive.

Application and demo board displays will include:

- Simpler topologies for three-phase inverters using 1200-V SiC diodes matched with its High Speed 3 IGBT
- CIPOS intelligent power module families
- GaN-based boards for telecom, server and consumer electronics
- XDP family digital power controllers
- High-integration/efficiency LED driver boards
- Automotive-qualified inverter modules
- And component-level displays will feature high-power IGBTs, discrete SiC devices and latest generation CoolMOS.

### **ROHM Semiconductor, booth 709**

ROHM Semiconductor will showcase its latest power technologies and solutions for the industrial, automotive, IoT, and consumer fields. Demos will highlight key products such as its [BD9V100MUF-C buck converter IC](#) with Nano Pulse Control and its SiC power devices, both of which target automotive applications.

Combining proprietary circuit design and layout with original processes allowed ROHM to develop ultra-high-speed pulse control technology that delivers the industry's highest step-down ratio (24:1) by achieving an on-time (pulse width) of just 9 ns, which is said to be ten times less than conventional products. This makes it possible to convert high voltages up to 60 V to the 3.3 V or 5 V required for vehicle systems using a single power chip (the BD9V100MUF-C) operating at 2 MHz. This halves the number of parts required and contributes to simpler system design.

Motor sports Formula E, the world's premiere racing class for electric vehicles, is garnering interest as a platform for further innovation in the electric car sector. Last year ROHM became an official technology partner of Formula E team Venturi, providing SiC power devices for inverters that comprise the core of the drive system in electric race cars. These devices will be featured in a demo.

Rohm will also be giving two Industry Session presentations on Thursday, March 8 in room 205. First from 9:21 am to 9:37 am Shingo Hashiguchi and Tetsuo Tateishi will give a talk on "A New Buck-Boost Converter That Eliminates the Right-Half-Plane-Zero" and then at 10:12 am to 10:38 am, Yuhei Yamaguchi and Tetsuo Tateshi will speak on the "Ultra-Narrow Pulse Buck Converter". This should be an interesting presentation for those who want to know more about how Rohm achieve its Nano Pulse Control in the BD9V100MUF-C buck converter IC.

### **NH Research, booth 727**

NH Research (NHR) will be displaying its 9400 family, a comprehensive line of test equipment used in the validation of ac-dc power conversion as well as energy storage products. The family features a range of models from 4 kW to 96 kW, programmable operation in any combination of ac single-phase, split-phase, three-phase or dc operating modes, built-in measurements, a 100% silicon-carbon (Si-C) design and product series including the 9410 regenerative grid simulator, the 9420 HiVar ac power source and the 9430 regenerative ac load.

These instruments are notable for their abilities to satisfy test requirements associated with key standards. For example, NHR's 9410 ac-dc grid simulator's 350-V L-N range fully covers both UL 1741 & IEEE 1547 standards. Meanwhile, NHR's 9420 ac-dc power source's frequency control up to 880 Hz fully covers MIL-704 and similar aviation standards. An additional ultra-low current measurement range is ideal for measuring standby power as required by energy efficiency standards.

In the case of NHR's 9430 ac-dc regenerative four-quadrant load, this instrument eliminates discrete components historically used to draw displacement current. Visit NHR in its booth or attend APEC's Test & Measurement Industry Session on Thursday March 8 in room 206 to learn more about the fundamentals of four-quadrant loading.

### **STMicroelectronics, booth 803**

Among the demos at STMicroelectronics' booth, highlights include the [USB-C for power delivery](#) and the [wireless charging portfolio](#) of Qi-certified receivers and transmitters for wireless power transfer from 1 W to 15 W.

USB connectivity has moved from a data-transfer to a device-charging standard with the wide adoption of micro-B ports on smartphones and nearly every other mobile device. Now a part of everyday life, the standard is again quickly evolving with the introduction of a new smart type-C connector. Able to deliver 100 W of power with a 10 Gbit/s data transfer rate, the Type-C connector also has the unique skills for switching to alternate or custom communication standards. Making the best use of these new features will open the door to new applications especially in the mobile, wearable, accessories and IoT arena.

At the booth, ST's USB-C demo features the two most typical use cases of power delivery. One is power negotiation using the STEVAL-USBPD45C 45W with the [STUSB4710](#) adapter as provider, and the P-NUCLEO-USB002 with the [STUSB1602 USB](#) as consumer. The second typical use case of power delivery demonstration shows alternate mode functionality with the STEVAL-USBC2DP, which is a Type-C-to-DisplayPort adapter.

As wireless power transfer technology continues to mature and user awareness increases, the reliability and robustness of these wireless charging systems continues to improve. In addition to enabling systems to be

waterproof so they are easier to clean and sterilize, new applications such as medical equipment and drones are beginning to emerge.

At APEC, ST will demonstrate the capabilities of its new STWBC-EP which supports the Qi Extended Power (15 W) profile. According to the vendor, the device combines best-in-class energy efficiency, consuming just 16 mW in standby and can wirelessly transfer more than 80% of the total input power, with unique features created by ST to enhance the user experience.

These features include a patented solution enhancing active presence detection to wake the system quickly when a compatible object is presented for charging. The patented technology also enhances the performance of Foreign Object Detection (FOD), to cut power and prevent overheating if objects containing metals are brought too close to the charger. To help accelerate time to market for product developers, ST has created an associated reference design with a Qi 15-W ready-built transmitter board and documentation.

The company will also be giving presentations on its new PWM technique, a combination PFC/LLC resonant controller, and a novel solution for data center power delivery.

A "Novel Adaptive Pulse Width Modulator provides Constant Switching Frequency in Fixed On/Off-Time controlled regulators" will be the topic of Giovanni Gritti's presentation scheduled for session T17 of the conference, Tuesday, March 6. Also on Tuesday in conference room 217A at 2:15 pm, Rosario Attanasio will discuss a "Digital combo multi-mode PFC and time-shift LLC resonant Controller."

On Wednesday, March 7, Paolo Sandri will share his expertise on "A Smart Implementation of Switched-Tank Converter System for Next-Gen 48V Data Center Power Delivery." For more on this subject, stop by the booth.

### ***Payton Planar, booth 819***

Payton Planar, which designs and manufactures planar magnetics, will be featuring a high-frequency, planar transformer in its exhibit. This 2.5-MHz, 800-W planar transformer achieves 99% efficiency in a 1-in. x 1-in. x 0.4-in. package. That equates to 2000 W/in<sup>3</sup>.

### ***Mitsubishi Electric US, booth 919***

This year Mitsubishi Electric US, Semiconductor and Device Division will exhibit for the first time at APEC, displaying its full lineup of power semiconductor products (formerly the Mitsubishi Products and Accessories Division of Powerex, Inc.).

Products on display will include the new 7th generation IGBTs, G1 Series IPMs, Version 6 DIIPMs (Dual Inline Package Intelligent Power Modules), SLIMDIPs (Slim Dual Inline Packages), DIIPM+, J1-Series Automotive modules, X-Series High Voltage IGBTs, and SiC solutions.

In addition, two papers will be presented by the MEUS application engineering team. One is "Dual High Voltage IGBT Modules with Metal Casting Direct Bonding (MCB) Baseplate" by Junya Sakai, Eric Motto, and Mike Rogers, which is to be presented on Wednesday, March 7, 2018 from 16:35 to 17:00 in room 213. The other is "Latest Power Semiconductor Packaging and Chip Technology," an exhibitor seminar which will be presented by Eric Motto on March 7 from 12:00 to 12:30 pm in room 217D.

### ***Wolfspeed, booth 1008***

Wolfspeed, A Cree Company, will be showcasing three products designed for on-board and off-board charging applications, which highlight the benefits of the company's SiC MOSFETs in powering electric vehicles. There will be three example power converters on display using the company's parts—a 20-kW two-level AFE converter, a 20-kW dc-dc converter, and a 6.6-kW bi-directional on-board charger (OBC).

Targeting on-board and off-board battery chargers, the 20-kW AFE platform delivers a >30% reduction in power loss when compared to an existing three-level Vienna rectifier, while also being capable of supporting bidirectional power flow (V2G). The two-level 20-kW dc-dc converter reduces parts count by 30% when compared with a conventional silicon-based interleaved LLC.

Finally, the 6.6-kW bi-directional OBC targets high-efficiency, high-power-density, on-board charger applications. The high voltage rating of Wolfspeed SiC MOSFETs allow the dc bus voltage to vary according to the battery voltage to achieve optimal efficiency.

Several spokespeople will be on-site at the booth to discuss how Wolfspeed's SiC power products play a role in key industries, such as EVs and energy storage.

### **GaN Systems, booth 1041**

GaN Systems will showcase what it describes as breakthrough GaN power transistor power levels and form factors. GaN Systems will also provide customer and application demonstrations showing how GaN is solving the power challenges of today's most demanding industries, including consumer electronics, data centers, automotive, renewable energy, and industrial. Furthermore, GaN Systems' experts will be presenting at several sessions illustrating how previously unattainable system performance is now a reality in many power-reliant industries.

GaN Systems will also announce an expansion of the company's GaN power transistors with the introduction of new products. For the consumer and data center applications, several integrated half-bridge with driver solutions will be highlighted. Additionally, GaN Systems will demonstrate several new evaluation boards such as the Insulated Metal Substrate (IMS) Evaluation Platform, which provides a flexible, low cost, high power development platform for high-efficiency power systems with 3-kW or higher applications.

### **Dialog Semiconductor, booth 1155**

Dialog Semiconductor will be demonstrating its technologies used in solutions for rapid charging including its GaN power IC and a charger IC. The [SmartGan DA8801](#) GaN half-bridge IC is said to offer more efficient switching and higher frequency operation to reduce wasted energy by half. This device enables faster battery charging without increasing size and allows for one adapter to be used for both laptop and mobile devices.

The DA9318 charger is optimized to handle high charging currents and at the same time ensure the safety of the battery and the system. It operates together with a main charger, which handles the pre-charge and constant voltage charging duties.

### **Power Integrations, booth 1245**

Power Integrations will highlight its latest innovations in ac-dc converters, LED drivers and gate driver products. Its team will be on-site for all three days to offer you application solutions, insights and details on our products. The company will also be giving talks in several sessions

On Tuesday, March 6 from 8:30 to 11:55 am in room 212, Michael Hornkamp will speak in the industry session on Isolation in Power Supplies—a session chaired by How2Power Today columnists, Kevin Parmenter and Jim Spangler. Then, from 1:30 to 2:00 pm in an exhibitor session in room 214D, Amruta Patra and Rahul Joshi will give a presentation on a "Digitally-Controlled Off-Line Flyback that Exceeds DOE (6) Efficiency for Wide Range and USB PD Power Supplies."

On Thursday, in the Control I poster session from 11:30 - 2:00 pm in the Hemisphere Ballroom C1 & C2, Andy Smith will participate with a technical paper poster on "New Communication and Isolation Technology for Integrated Gate Driver IC Solutions Suitable for IGBT and Si/SiC MOSFETs: Gate Drive Units, Intelligent Integrated Drivers".

### **Efficient Power Conversion (EPC), booth 1255**

EPC will exhibit live demonstrations showing how GaN technology's superior performance is transforming power delivery for entire industries including computing, communications, and automotive. In addition, the EPC team will be delivering seven technical presentations on gallium nitride (GaN) technology and applications.

The company will demonstrate its latest eGaN FETs and ICs in customers' end products that are enabled by eGaN technology. Demonstrations will include a high-power density 48-V to 12-V nonisolated converter capable of delivering over 700 W. In addition, a range of 3-D real-time LiDAR imaging sensors used in autonomous vehicles will be displayed. EPC will also display its single desktop implementing a high power resonant wireless charging solution capable of generating 300 W to wirelessly power a wide range of devices including cell phones, notebook computers, monitors, wireless speakers, smart watches, and table lamps.

Among the presentations being given by EPC experts are an education seminar and several exhibitor seminars.

The education seminar "Maximizing GaN FET and IC Performance, Not Just a Drop in Replacement of MOSFETs" will be presented by Alex Lidow, Michael de Rooij, David Reusch, and John Glaser. These same presenters will give a host of exhibitor seminar talks including "GaN Transistors for Efficient Power Conversion," "Moving Up in Voltage with eGaN FETs," "Amplifier Design Challenges for Large Area Highly Resonant Wireless Power Systems" by Michael de Rooij and Yuanzhe Zhang ; "Evaluation of Measurement Techniques for High-Speed GaN Transistors" by Suvankar Biswas and Tom Neville (Tektronix); "Design Considerations for GaN Transistor

Based Synchronous Rectification"; and "System Optimization of a High-Power Density Non-Isolated Intermediate Bus Converter for 48 V Server Applications".

### ***OPAL-RT Technologies, booth 1326***

National Instruments (NI) and OPAL-RT aim to provide automakers around the globe with a leading electrical motor HIL solution. Visitors can witness the demonstration of new standards in an ever-evolving industry as the company showcase (CHASSIS NI) running on an (FPGA), the latest evolution in FPGA Electrical Motor real-time simulation. Also, join the company at its booth for an exciting HIL & Microgrid Testbed demo on a Rapid Control Prototyping from Imperix.

### ***Renesas, booth 1436***

The Renesas team will demo several high-performance intelligent power solutions for applications ranging from battery-powered consumer electronics to power tool equipment, and the Internet of Things (IoT) cloud infrastructure. Among the demos are a USB Power Delivery (PD) solution, integrated motor drive solutions and a smart power design with complete digital multiphase solutions.

The Renesas USB-PD solution highlights seamless, efficient USB PD 3.0 and USB type-C power delivery for a wide range of applications, including ultrabooks, ac-dc power adapters, hubs, and power banks. The company will demonstrate a combo USB PD 3.0 controller and USB Type-C bidirectional buck-boost voltage regulator solution that offers built-in authentication, configurable firmware, 5-V to 20-V output, and supports source, sink, and cable.

The company's integrated motor drive solutions demonstrate how to easily control and drive three-phase BLDC motors used in battery-operated power tools and cleaning robots, among other applications, using high-performance sensor-less motor drive control. The solutions feature a single system-on-chip (SoC) that combines an MCU, analog front end, and customized firmware to drive a motor with optimized efficiency and minimum heating.

Renesas will also showcase intelligent power control with its digital multiphase controller and smart power stage solutions, designed to provide ultra-fast transient response and support the industry's ever-growing current load requirements. The VR13 system board demonstrates a digitally configurable solution to address demanding CPU core voltages, memory, and auxiliary power rails in cloud server computing applications.

The IMVP8 evaluation platform demonstrates a scalable digital platform for desktop and embedded applications. The AVSBus evaluation platform supports PMBus and AVSBus to connect directly to the processor for communicating telemetry data and deliver efficiency savings through adaptive voltage positioning.

### ***Baknor Thermal Management, booth 1718***

Baknor will introduce its graphene-based FILM heat sink. The company uses a patented engineering method that integrates graphene, which has a thermal conductivity of 5300 W/m•K with diamond powder particles, which have a thermal conductivity of 2300 W/m•K, into a rectangular structure. This allows thermal conduction without any interruption while filling the holes of the structure mesh with carbon nanocapsules to increase the thermal radiation efficiency.

The graphene-based FILM heat sink maximizes the thermal radiation cooling effect because the high polarizability of the nano materials enables them to spread evenly on the surface of the film. Thermal spreading occurs in all three planes (x, y and z) for graphene while for graphite it occurs in only two planes (x and y). In terms of electrical insulation, the heat sink's nano structure strengthens electrical insulation so that it can withstand voltage above 3 kV. To facilitate greater thermal radiation, it's also possible to add a metal layer beneath the film to speed up the heat emission to the nano structure layer.

### ***SABIC, booth 1728***

SABIC will introduce its new ULTEM polyetherimide (PEI) dielectric film for high-temperature, professional-grade capacitor applications. The new film will be the latest addition to SABIC's growing family of ULTEM dielectric film technologies, developed to give customers in multiple industries – including automotive, defense, aerospace, consumer electronics, electric train and renewable energy – the ability to address increased temperature and voltage requirements arising from advanced new designs.

SABIC's participation in APEC 2018 will also include a presentation by application development technical specialist, Neal Pfeiffenberger, whose presentation will focus on the new film and is scheduled for Wednesday, March 7, at 12:00 p.m., in session room 217C.